IEEE P1451.5 Wireless Sensor Interface Working Group Bluetooth Subgroup Proposal

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Why Bluetooth?

Enable short-range unconscious radio communications & personal area networks
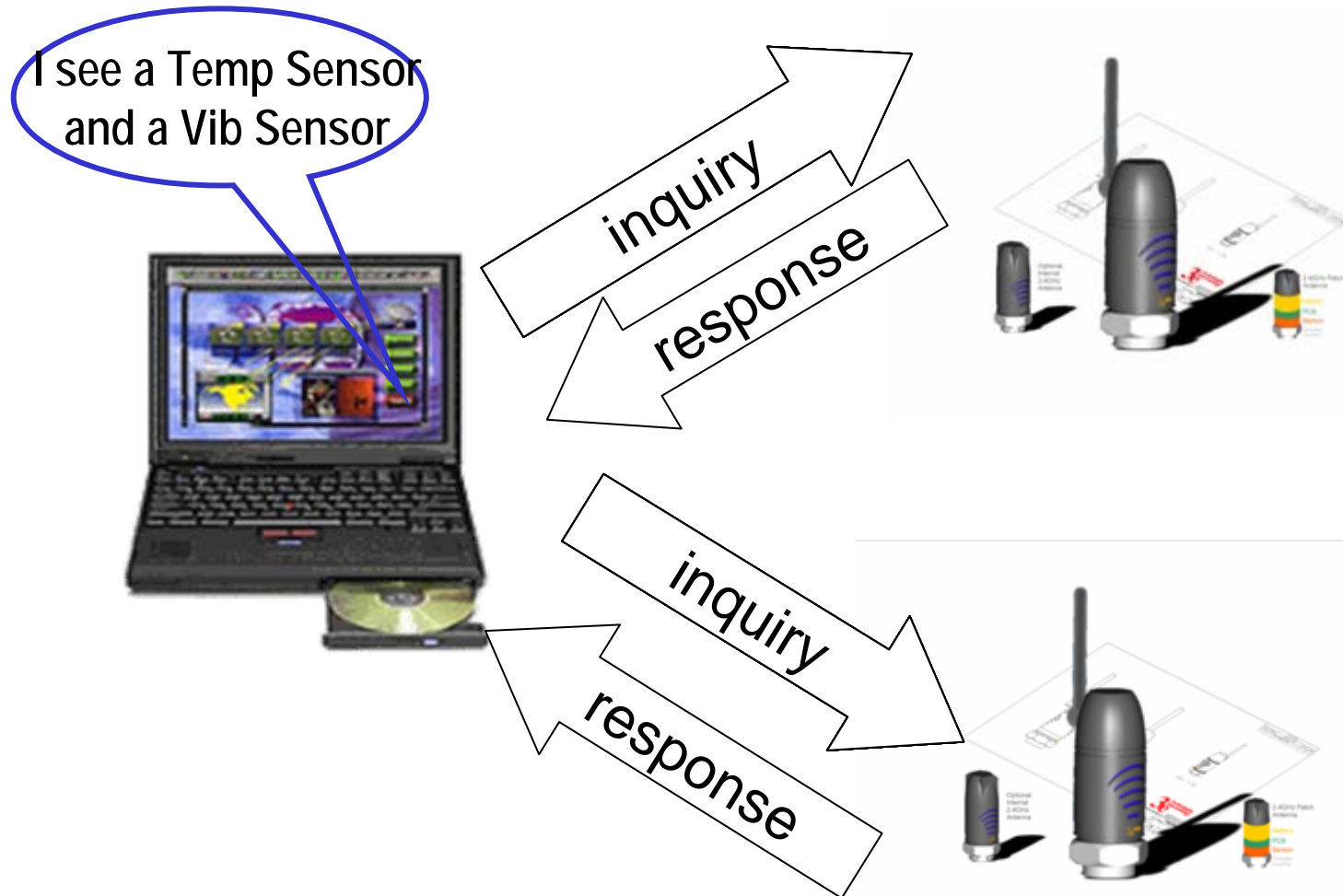
Key enablers:

- Low cost

- Robust and reliable

- Low user maintenance

    - Easy to enable, easy to use

    - Upwards compatibility
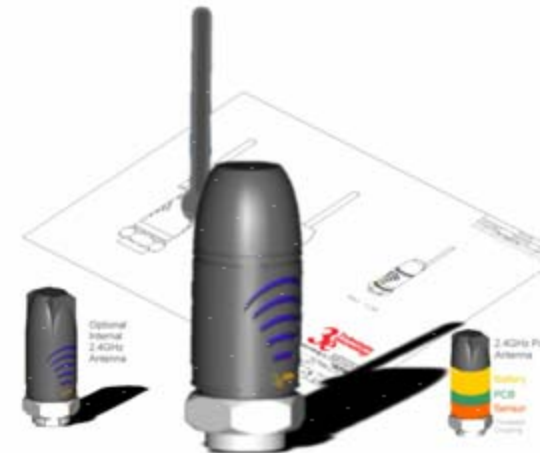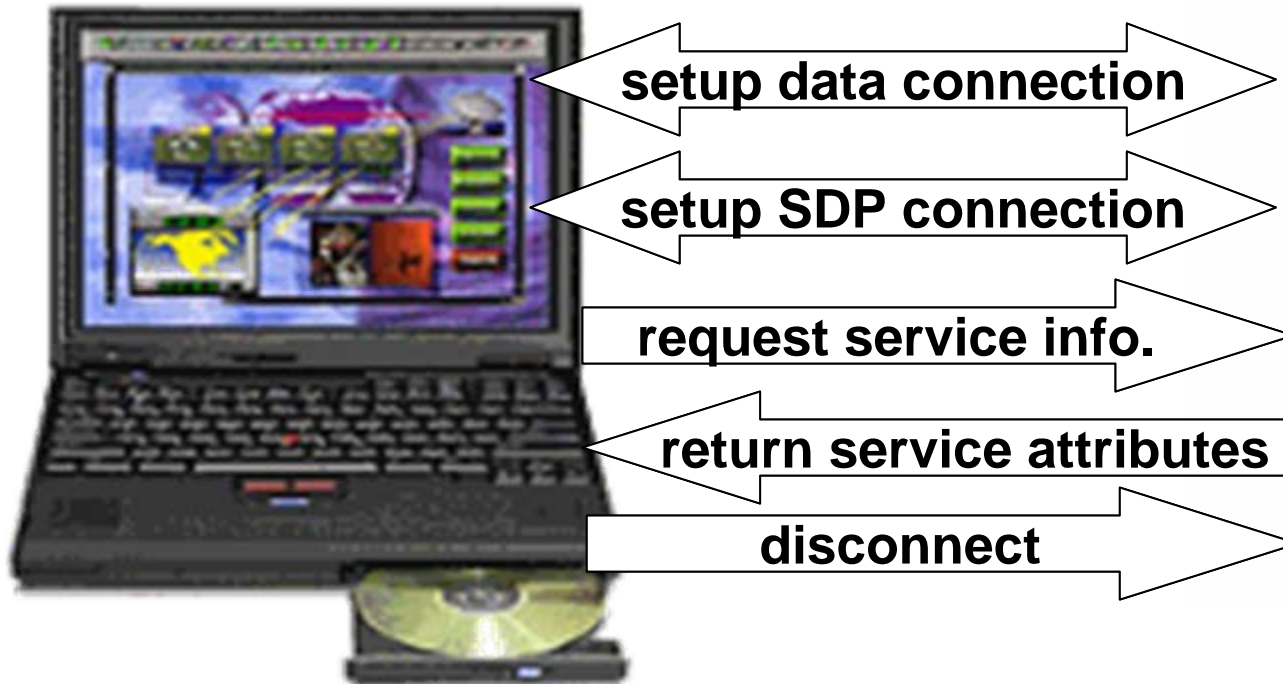
Bluetooth Features for IEEE1451.5

Bluetooth has many features that make it a suitable wireless technology for IEEE1451.5

- Device Discovery
  - Bluetooth Inquiry mode allows devices to be discovered
  - The Class of Device identified during inquiry allows filtering for device types
  - Bluetooth Service Discovery Profile (SDP) allows for browsing for features and services
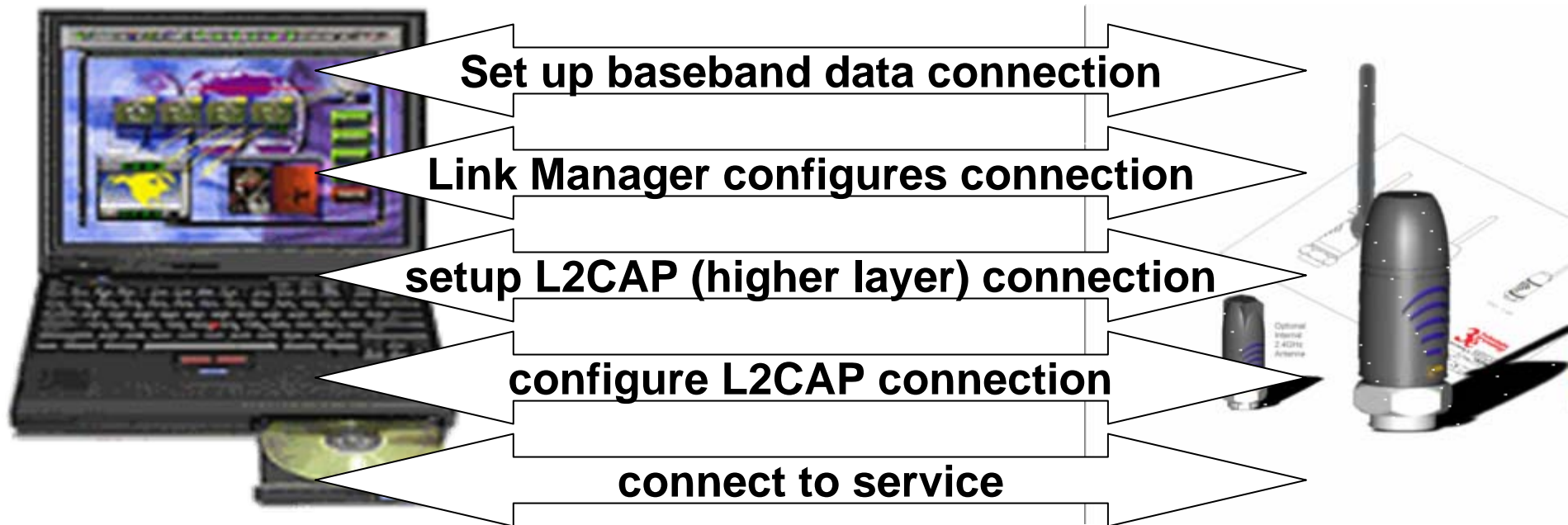
Device Discovery

Service Discovery

Connection to a service

Set up baseband data connection

Link Manager configures connection

setup L2CAP (higher layer) connection

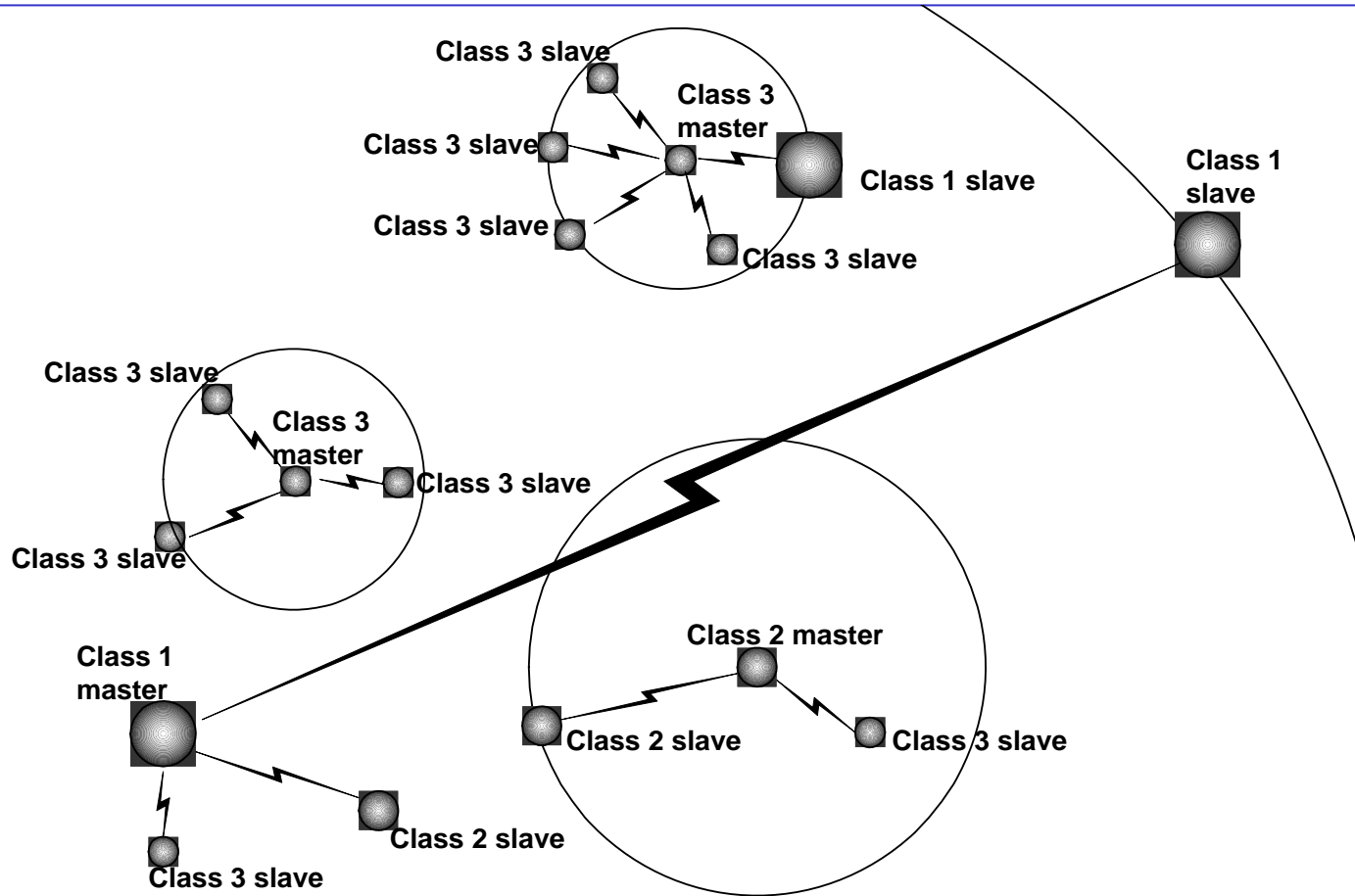configure L2CAP connection

connect to service

Bluetooth Features for IEEE1451.5

Bluetooth has many features that make it a suitable wireless technology for IEEE1451.5

- Connections
  - Bluetooth allows piconets with point to multipoint connections of up to 7 slaves to one master
  - More devices can be served by making fast connections (as low as 40 msec)
  - Data rates up to 723 Kbytes using asynchronous (ACL) channels
  - Synchronous (SCO) channels for data streaming
  - Reliable ACL channels (with retransmission)
  - L2CAP layer implements service multiplexing and fragmentation and reassembly
  - Quality of Service is negotiable to include low latency or high reliability channels
  - The Bluetooth clock can be used to implement time synchronization across a piconet
  - Low power modes to allow battery powered devices with projected life in years

Masters and slaves in piconets

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Advantages that Bluetooth Features offer IEEE1451.5

Architecture

– Bluetooth protocol stack can be implemented on two processors as a host and controller (radio) using the Host Controller Interface (HCI)

– NCAP can implement the host on a second processor with controller on a single chip Bluetooth device for maximum performance in multipoint scenarios

– TIM can be implement on a single chip Bluetooth device (no extra microcontroller)

– Complete single chip TIM measurement systems possible with re-use of chips containing ADCs and DSPs designed for commercial audio applications

Commercial

– Many commercial HHDs, PCs and mobile phones support Bluetooth

– Low cost re-use of commercial technology for industrial market

– Bluetooth is shipping now in volume – over 120 M solutions predicted for 2004

– Chip prices now below $4, falling to $2 in 2006

Bluetooth Proposal for IEEE1451.5

Architecture

- IEEE1451.5 implemented using Bluetooth Network Encapsulation Protocol (BNEP) transport
- BNEP is lightweight protocol with as low as single byte overhead
- Allows re-use of Bluetooth address (MAC address) to reduce protocol overhead in point to point links
- BNEP can also transport IP packets, so alternative implementations or extensions to include routing are possible.

Channels

- Use ACL channels for datagram triggering and streaming services
- Use Bluetooth clock for synchronization
- Use QoS interface to configure data channels

Bluetooth Proposal for IEEE1451.5

Device Discovery

– Using Bluetooth Inquiry and Paging modes

TEDS

– Single chip TIMs can use SDP database to store TEDS

– SDP protocol allows for efficient TEDS browsing and retrieval from NCAP

Performance

– Proposed IEEE1451.0 datagram has 13 byte header

– Smallest Bluetooth packet has 17 byte payload so single readings can be transported in a single data packet for maximum throughput and minimum latency

Bluetooth IEEE1451.5 Example
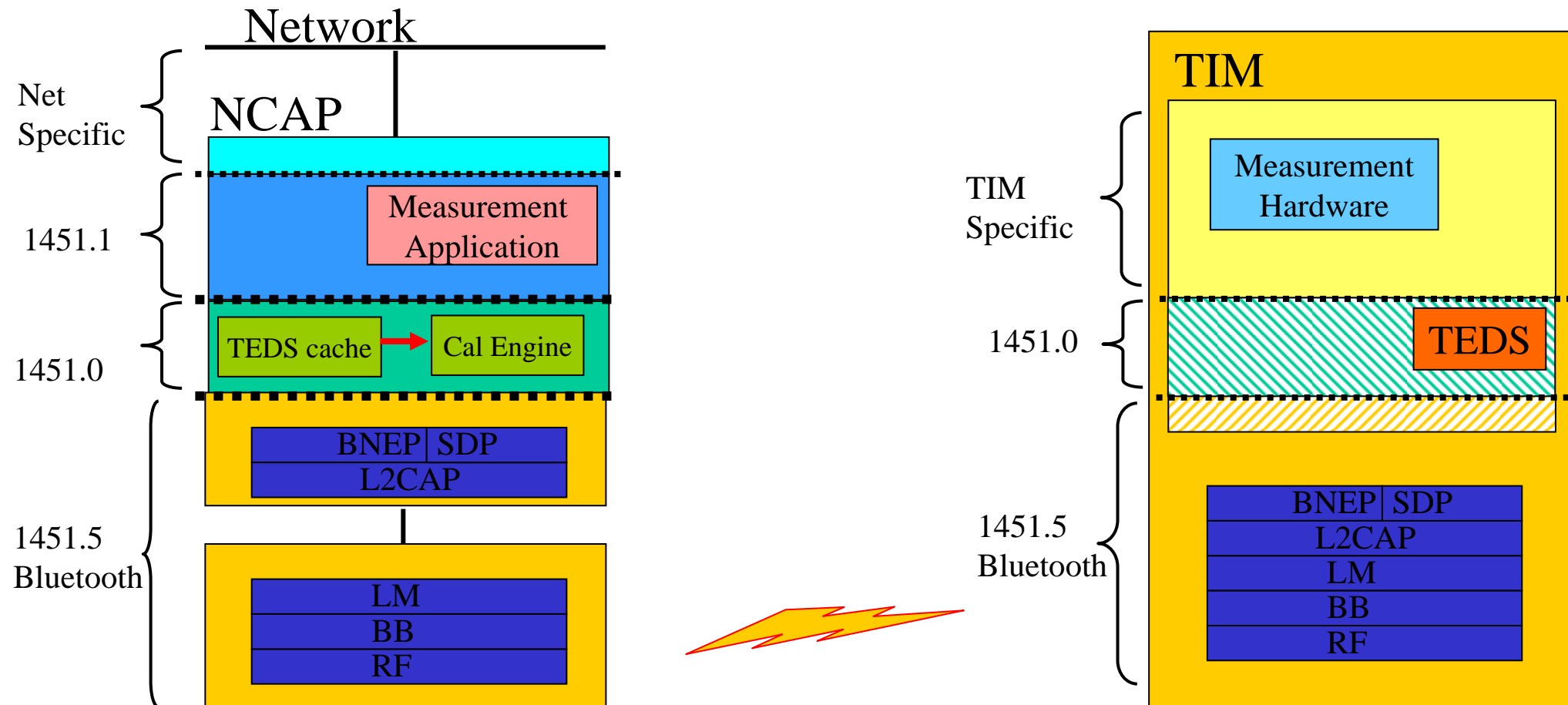
Summary

- Bluetooth offers industrial users a low cost, high performance and secure wireless technology that is mature and in mass commercial production

- The Bluetooth IEEE1451.5 proposal will allow re-use of low cost commercial technology to deliver high performance smart sensor handling capability

- The proposal will make use of existing Bluetooth protocols and profiles so only thin dot0/dot 5 applications will have to be implemented

- The proposal will be extendable to take advantage of future developments in Bluetooth, including Enhanced Data Rate (EDR) which increases data rate to over 2 Mbps, and is scheduled for Q4 2004